Implementation of arclength methods for nonlinear finite element simulations

Bachelor or Master's thesis (Computational Methods in Engineering, Maschinenbau, Mathematik)
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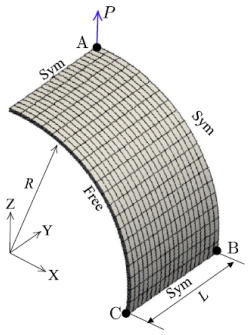
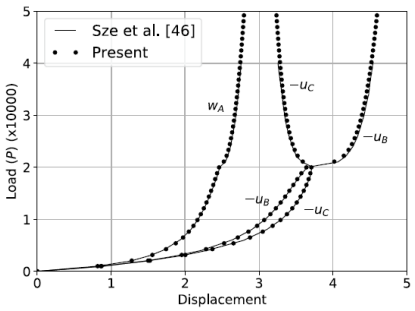
Scope of Work

Nonlinear structures experience complex deformation behavior beyond limit points, e.g., post-buckling, plastic yielding, or damage. Hence, nonlinear finite element simulations are the backbone of many applications in engineering and science. One important issue is the resistance of structural designs made of truss-like structures or thin-walled components against buckling. For computing the complex nonlinear response of such structures, the arclength method has become the de facto standard considering incremental-iterative solution schemes in computational structural mechanics.





The main goal of this thesis is to implement a state-of-the-art arclength solver and to study its performance by means of several benchmark problems. An area of application is seen in the stability of cylindrical shells, which are reminiscent of an aircraft fuselage.

Tasks

- Review of the existing literature on nonlinear solutions methods
- Familiarize yourself with displacement and load control in Newton methods
- Implementation of an arclength solver in an existing in-house FE-code
- Investigations regarding the postbuckling behavior of cylindrical shells

Prerequisites

- Computational mechanics (e.g., (Nonlinear) Finite Element Method)
- Programming skills (preferably Matlab or Julia)
- Continuum Mechanics

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